CLAIMS

1. A vibratory rotational rate sensor comprising:

a vibratory element including a pair of vibratory masses disposed symmetrically along a common axis for vibration along the axis;

a driver coupled to at least one vibratory mass for inducing periodic motion in the vibratory masses along the axis;

a first sense circuit coupled to at least one of the vibratory masses for sensing motion of the vibratory mass in one direction orthogonal to the vibratory axis; and

a second sense circuit coupled to at least one of the vibratory masses for sensing motion of the vibratory mass in another direction orthogonal to the vibratory axis.

2. A vibratory rotational rate sensor as in claim 1 wherein the driver induces counter-phase motion between the vibratory masses.

3. A vibratory rotational rate sensor as in claim 1 wherein the vibratory masses include magnetic elements and the driver and the sense circuits include electromagnetic elements.

4. A vibratory rotational rate sensor as in claim 1 wherein the driver is coupled to one vibratory mass and the sense circuits are coupled to the other vibratory mass.

5. A vibratory rotational rate sensor as in claim1 wherein the driver is periodically coupled to one vibratory mass and the sense circuits are coupled to the same vibratory mass during times when the driver is not.

6. A vibratory rotational rate sensor as in claim 1 wherein the one and the other directions are coplanar and generally orthogonal to one another.

7. A vibratory rotational rate sensor as in claim 1 including a motion sensor for sensing the amplitude and phase of the motion of the vibratory masses along the vibratory axis, wherein the motion sensor is coupled to the driver, and the driver drives the vibratory masses in a repeatable manner in response to the sensed amplitude and phase.

8. A vibratory rotational rate sensor as in claim 1 further comprising a planar restoring element having resilient first members coupled to one of the masses and resilient second members coupled to the other of the masses.

9. A vibratory rotational rate sensor as in claim 8 further comprising a single homogeneous restoring element having resilient first members coupled to each of the masses.

10. A vibratory rotational rate sensor as in claim 8 wherein the resilient first and second members are elongated such that they have a length greater than the straight-line distance between their ends.

11. A vibratory rotational rate sensor as in claim 8 wherein the restoring element further includes resilient mounting members for connecting the vibratory assembly to an external mount.

12. A vibratory rotational rate sensor as in claim 1 wherein the resonances of the counter-phase motion and the sensed motion are sufficiently close to magnify the sense mode motion and other resonant modes are spaced sufficiently far in frequency so that they can be effectively removed by filtering.

13. A vibratory rotational rate sensor as in claim 8 wherein the planar restoring element is radially X-fold symmetric, X being an integer 3 or greater.

14. A method for operating a vibratory rotational rate sensor, the rate sensor including a pair of vibratory masses disposed symmetrically along a common axis for vibration along the axis, the method comprising the steps of:

driving at least one vibratory mass for inducing periodic motion in the vibratory masses along the axis;

sensing motion of at least one of the vibratory masses in one direction orthogonal to the vibratory axis; and

sensing motion of at least one of the vibratory masses in another direction orthogonal to the vibratory axis.

15. A method for operating a vibratory rotational rate sensor as in claim 14 wherein the step of driving induces counter-phase motion between the vibratory masses.

16. A method for operating a vibratory rotational rate sensor as in claim 14 wherein the vibratory masses include magnetic elements and the steps of sensing are done electromagnetically.

17. A method for operating a vibratory rotational rate sensor as in claim 14 wherein the driver is coupled to one vibratory mass and the sense circuits are coupled to the other vibratory mass, wherein the step of driving drives one of the vibratory masses and the steps of sensing sense the motion of the other vibratory mass.

18. A method for operating a vibratory rotational rate sensor as in claim 14 wherein the step of driving drives one vibratory mass intermittently and the steps of sensing sense the motion of the one vibratory mass during times when it is not being driven.

19. A method for operating a vibratory rotational rate sensor as in claim 14 wherein the one and the other directions are coplanar and generally orthogonal to one another.

20. A method for operating a vibratory rotational rate sensor as in claim 14 further including the step of sensing the amplitude and phase of the motion of at least one of vibratory masses along the vibratory axis, and the step of driving drives the vibratory masses in a repeatable manner in response to the sensed amplitude and phase.